1. What is the concept of human learning? Please give two examples.

Ans> Learning is the process of acquiring new understanding, knowledge, behaviors, skills, values, attitudes, and preferences. Humans acquire knowledge through experience either directly or shared by others.

Humans begin learning by memorizing.Then he practices on transforming the data stored in memory to knowledge and applies them to develop skills to solve problems faced in real life. A person with Human intelligence sustains, but his knowledge fades as new technologies emerge. Humans without knowledge in particular subjects can apply their intelligence to solve problems in new domains.good memory and more knowledge without the required skills cannot be considered intelligent.

examples: Learning to drive a motor-car, typewriting, singing or memorizing a poem or a mathematical table, and music etc.

2. What different forms of human learning are there? Are there any machine learning equivalents?

Ans: Three Major Types of Learning

1) Learning through association - Classical Conditioning

A new, conditional reaction can be added to a natural, mostly innate, so-called unconditional response through learning- **Resembles to Reinforcement learning**

2) Learning through consequences – Operant Conditioning

Some types of behavior can be modified by using reinforcements and punishments- **Resembles to Reinforcement learning**

3) Learning through observation – Modeling/Observational Learning

In Ml, instances are the observations, features are the explanatory factors (grouped into feature vectors), and classes are the portable categories to be predicted. **So in short the program learns by observing the data i.e observations.**

3. What is machine learning, and how does it work? What are the key responsibilities of machine learning?

Ans: Machine learning is a branch of artificial intelligence (AI) that allows computers to learn and develop on their own without having to be specifically coded. Machine learning is concerned with the creation of computer programs that can access data and learn on their own.

A machine learning engineer (ML engineer) is a professional in the field of information technology who specializes in the development of self-contained artificial intelligence (AI) systems that automate the usage of prediction models. The AI algorithms capable of learning and making predictions are designed and built by machine learning engineers (ML).

4. Define the terms "penalty" and "reward" in the context of reinforcement learning.

Ans: Reinforcement learning is all about gamifying the learning process. This type of machine learning uses a reward-penalty method to teach an AI system. *If it makes the right move, it gets rewarded. If it makes a mistake, it receives a penalty*

**Reward:** For every action made, the agent receives a reward from the environment. A reward could be positive or negative, depending on the action.

**Penalty:** Negative reinforcement involves increasing the chances of specific behavior to occur again by removing the negative condition.

For example, if a child fails a test, they can be negatively reinforced by taking away their video games. This is not precisely punishing the child for failing, but removing a negative condition (in this case, video games) that might have caused the kid to fail the test.

5. Explain the term "learning as a search"?

Ans: Learning can be viewed as a search through the space of all sentences in a concept description language for a sentence that best describes the data.

Alternatively, it can be viewed as a search through all hypotheses in a hypothesis space. In either case, a generality relation usually determines the structure of the search space.

The input to a learning program consists of descriptions of objects from the universe (the [training set](https://doi.org/10.1007/978-0-387-30164-8_843)) and, in the case of [supervised learning](https://doi.org/10.1007/978-0-387-30164-8_803), an output value associated with the example. A program is limited in the concepts that it can learn by the representational capabilities of both the [observation language](https://doi.org/10.1007/978-0-387-30164-8_608) (i.e., the language used to describe the training examples) and [hypothesis language](https://doi.org/10.1007/978-0-387-30164-8_372)(the language used to describe the concept).

6. What are the various goals of machine learning? What is the relationship between these and human learning?

Ans: The goal of machine learning is often — though not always — to train a model on historical, labelled data (i.e., data for which the outcome is known) in order to predict the value of some quantity on the basis of a new data item for which the target value or classification is unknown. We might, for example, want to predict the lifetime value of customer XYZ, or to predict whether a transaction is fraudulent or not.

**The Goals of Machine Learning.**

The goal of ML, in simple words, is to understand the nature of (human and other forms of) learning, and to build learning capability in computers. To be more specific, there are three aspects of the goals of ML.

1. To make the computers smarter, more intelligent. The more direct objective in this aspect is to develop systems (programs) for specific practical learning tasks in application domains.
2. To develop computational models of the human learning process and perform computer simulations. The study in this aspect is also called cognitive modeling.
3. To explore new learning methods and develop general learning algorithms independent of applications.

7. Illustrate the various elements of machine learning using a real-life illustration.

Ans: Elements of Machine learning

1. Data simply means information. All types and formats of information. Data can be structured or unstructured and raw. Data generated by sensors, processes in industries, customer vendor data in sales and marketing
2. Task: The task to achieve using the data. Task is like predicting the house price, prediction the rainfall etc
3. Model.: A mathematical function which defines the relationship between input and output data. Models like linear, classification etc
4. Loss function : Computing the difference between output of model and actual values for all the data using the loss function. ex. Squared loss, cross entropy loss, KL divergence
5. Learning Algorithm: while building a model for various feature we define various parameters. So, to identify these parameters for a model, we need a learning algorithm. using various optimization strategies available that we can use to find the best parameter values of parameters which minimizes the loss. Ex. of such optimization solvers are Gradient DEscent, Adagrad, RMSPRrop etc.
6. Evaluation Testing the model if it predicts the correct output in all the cases. If not how accurate the model is?

8. Provide an example of the abstraction method.

Ans: ex. When we use the Tv remote to increase the Volume. We don’t know how pressing a key increases the volume of the TV. We only know to press the “+” button to increase the volume. That is exactly how the abstraction works in the OOPs.

In Python, an abstraction is used to hide the irrelevant data/class in order to reduce the complexity. It also enhances the application efficiency.

Abstract Classes: Syntax

from abc import ABC

class ClassName(ABC):

9. What is the concept of generalization? What function does it play in the machine learning process?

Ans: A generalization is a form of abstraction whereby common properties of specific instances are formulated as general concepts or claims.[1] Generalizations posit the existence of a domain or set of elements, as well as one or more common characteristics shared by those elements (thus creating a conceptual model). As such, they are the essential basis of all valid deductive inferences (particularly in logic, mathematics and science), where the process of verification is necessary to determine whether a generalization holds true for any given situation.

In machine learning:

Generalization refers to your model's ability to adapt properly to new, previously unseen data, drawn from the same distribution as the one used to create the mode

1. Variance-bias trade-off

The prediction results of a machine learning model stand somewhere between a) low-bias, low-variance, b) low-bias, high-variance c) high-bias, low-variance, and d) high-bias, high-variance. A low-biased, high-variance model is called overfit and a high-biased, low-variance model is called underfit. By generalization, we find the best trade-off between underfitting and overfitting so that a trained model obtains the best performance. An overfit model obtains a high prediction score on seen data and low one from unseen datasets. An underfit model has low performance in both seen and unseen datasets.

10. What is classification, exactly? What are the main distinctions between classification and regression?

Ans: Classification is a systematic grouping of observations into categories.

Inorder to determine correct categories for a given observation,ML technology does the following.

1. Applies a classification algorithm to identify shared characteristics of certain classes.
2. compares those characteristics to the data you’re trying to classify.
3. Uses that information to estimate how likely it is that observation belongs to a particular class.

Main distinction between

| **Regression Algorithm** | **Classification Algorithm** |
| --- | --- |
| In Regression, the output variable must be of continuous nature or real value. | In Classification, the output variable must be a discrete value. |
| The task of the regression algorithm is to map the input value (x) with the continuous output variable(y). | The task of the classification algorithm is to map the input value(x) with the discrete output variable(y). |
| Regression Algorithms are used with continuous data. | Classification Algorithms are used with discrete data. |
| In Regression, we try to find the best fit line, which can predict the output more accurately. | In Classification, we try to find the decision boundary, which can divide the dataset into different classes. |
| Regression algorithms can be used to solve the regression problems such as Weather Prediction, House price prediction, etc. | Classification Algorithms can be used to solve classification problems such as Identification of spam emails, Speech Recognition, Identification of cancer cells, etc. |
| The regression Algorithm can be further divided into Linear and Non-linear Regression. | The Classification algorithms can be divided into Binary Classifier and Multi-class Classifier. |

11. What is regression, and how does it work? Give an example of a real-world problem that was solved using regression.

Ans: Regression is a process of finding the correlations between dependent and independent variables.

Linear regression algorithm works:

Linear regression is a supervised machine learning method that is used by the Train Using AutoML tool and finds a linear equation that best describes the correlation of the explanatory variables with the dependent variable. This is achieved by fitting a line to the data using least squares. The line tries to minimize the sum of the squares of the residuals. The residual is the distance between the line and the actual value of the explanatory variable. Finding the line of best fit is an iterative process.

Linear Regression Real Life Example:

Medical researchers often use linear regression to understand the relationship between drug dosage and blood pressure of patients.For example, researchers might administer various dosages of a certain drug to patients and observe how their blood pressure responds. They might fit a simple linear regression model using dosage as the predictor variable and blood pressure as the response variable. The regression model would take the following form:

blood pressure = β0 + β1(dosage)

The coefficient β0 would represent the expected blood pressure when dosage is zero.

The coefficient β1 would represent the average change in blood pressure when dosage is increased by one unit.

If β1 is negative, it would mean that an increase in dosage is associated with a decrease in blood pressure.

If β1 is close to zero, it would mean that an increase in dosage is associated with no change in blood pressure.

If β1 is positive, it would mean that an increase in dosage is associated with an increase in blood pressure.

Depending on the value of β1, researchers may decide to change the dosage given to a patient.

The task of the Regression algorithm is to find the mapping function to map the input variable(x) to the continuous output variable(y).

12. Describe the clustering mechanism in detail.

Ans: Clustering is the task of dividing the population or data points into a number of groups such that data points in the same groups are more similar to other data points in the same group than those in other groups. In simple words, the aim is to segregate groups with similar traits and assign them into clusters.

It is basically a collection of objects on the basis of similarity and dissimilarity between them.

13. Make brief observations on two of the following topics:

**i. Machine learning algorithms are used**

**Ans:**

Machine learning algorithms use historical data as input to predict new output values. Recommendation engines are a common use case for machine learning. Other popular uses include fraud detection, spam filtering, malware threat detection, business process automation (BPA) and Predictive maintenance.

ii. Studying under supervision

iii. Studying without supervision

**iv. Reinforcement learning is a form of learning based on positive reinforcement.**

**Ans :**

* Reinforcement Learning is a feedback-based Machine learning technique in which an agent learns to behave in an environment by performing the actions and seeing the results of actions. For each good action, the agent gets positive feedback, and for each bad action, the agent gets negative feedback or penalty.
* In Reinforcement Learning, the agent learns automatically using feedback without any labeled data, unlike supervised learning.
* Since there is no labeled data, the agent is bound to learn by its experience only.
* RL solves a specific type of problem where decision making is sequential, and the goal is long-term, such as **game-playing, robotics**, etc.
* The agent interacts with the environment and explores it by itself. The primary *goal of an agent in reinforcement learning is to improve the performance by getting the maximum positive rewards*.